EPISTEMOLOGY, CULTURE AND PHYSICS EDUCATION: IMPLICATION FOR SUSTAINABLE DEVELOPMENT

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Abstract

The knowledge and belief of a people form significant component of their culture. The culture is embedded in the ways they think, perceive and behave even in learning situations. How learning takes place have been established in the literature to depend significantly on attitude. Learners attitude towards learning encompasses the language, mode and competence in the delivery of instruction. Aboriginal language and culture influence learning and allow learners to embrace instructions with peculiarity to their lineage. This study examines the confluence of belief, culture, and learning of physics within and outside the classroom. Inferences drawn based on the findings of various researchers regarding all reflected components in this study. Specifically, this study investigated the extent to which all the aforementioned variable influence students learning of physics, taking into consideration the role of physics education in the attainment of Sustainable Development Goals (SDGs) of the United Nations.

Keyword: Epistemology, Culture, Physics Education, SDGs

Introduction

Epistemology is often viewed as a branch of philosophy which deals with the study of knowledge and beliefs. In the context of Physics Education, epistemology deals with the nature of physics and physics knowledge by raising questions on -how we know what we know, how to create new knowledge, how one draws inferences, and how one makes sense of physical laws, theories and principles. Students' epistemological beliefs and attitudes are inter-related and have great impact on their approach to learning as well as time spent on organizing the knowledge structure. Scholarly put, epistemology is an area of justified belief and knowledge or the study of the method and grounds of knowledge especially with reference to its limits and validity (Tennis, 2008).

Culture may be defined as the total pattern of human behavior and its products embodied in thought, speech, action, and artifacts. Culture is dependent upon man's capacity for learning and transmitting knowledge to succeeding generations through the use of tools, language, and systems of abstract thought. The body of customary beliefs, social forms, and material traits constituting a distinct complex of tradition of a race and religion could also be referred as culture (Thomas, 2003). Science concerns itself with observation and classification of facts, especially with the establishment or strictly with the quantitative formulation of verifiable general laws chiefly by induction and

hypotheses, rather, a body of knowledge, a way of investigating or method, and a way of thinking in pursuit of understanding nature (Abimbola & Omosewo, 2006). Physics is a major branch of science that is concerned with the laws that govern the structure of the universe, the forms of matter, energy and their interaction. Physics also deals with matter and energy and their interactions in the fields of mechanics, acoustics, optics, heat, electricity, magnetism, radiation, atomic structure, and nuclear phenomena (Omosewo, 2009).

The teaching of physics at all levels of education are intended to produce scientists/physicist who are able to design the technological devices that could make day-to-day activities easier and living more comfortable (Ajayi, 2008). Therefore, to ensure a good and more comfortable environment for any society, the knowledge of physics and the adoption of appropriate mode of knowledge dissemination is sacrosanct. In essence, study of Physics can directly contribute to the much needed scientific and technological development necessary to provide a good working environment and national development, if well taught by the teacher and well learnt by the students.

Education ascribe in itself a significant role in human socio-economic development. United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2012 identified education as one of the principal activity which contributes to peace building, poverty eradication, lasting development and inter-cultural dialogue among others. These aims have global implication despite its localized approach. This localization approach is known to bring significant effects to sustainability. In line with the decade of education for sustainability by UNESCO, preservation of aboriginal knowledge domestic to a particular culture highlights the education of the young. These are thematic areas for sustainable development priorities of UNESCO and an extension of their initial projects that include Literacy for All (LFA) in 2000 aimed at scientific and technological literacy for all (Torres, 2000). The cultural pillar in education is achievable with the goal of integrating principles, values, and practices of sustainable development goals into all aspects of physics education to address the social, economic, cultural and environmental issues the world has to contend with. In line with the UNESCO theme of life-long learning and learning for life. The knowledge and application of physics may be the foundation for life-long learning and could be considered as key element of both inter and cross generational learning (Torres, 2000).

Interplay among Culture, Attitude and the Knowledge of Physics

Jordan, Carlile, & Stack (2008) posited that formal education produces students who are culturally aware. Students' cultural perspective can be said to significantly improve how they construct knowledge while their cultural background may influence cognitive style and motivation. Cross-cultural strategies often referred as cultural integration provide opportunities for students to learn physics content taught in the context of community culture and tradition. Students adhere to autonomous acculturation which emphasizes learning physics content the western way, nonetheless, adhering to characteristic culture and tradition peculiar to a particular area also helps learning significantly. The physics curriculum in Nigeria like many other African countries envisions attaining skills through localization of senior school education (FRN, 2013).

Researchers have reported that students' expectation in physics and choice of future career emanate from their attitude, beliefs, and assumptions about physics (May & Etkina, 2002; Hammer, 2000). Expectations are incorporated into learners' ideas of what comprises physics learning, as well as their thoughts about their own role in the learning process. The knowledge that is gained prior to formal instructions as perceptive beliefs or common-sense knowledge are based on prior beliefs (Sherin, 2006). Sometimes these prior beliefs can lead to different understandings of the same situations by different learners. Student brings a set of attitudes, beliefs, and assumptions about what sorts of things they will learn, what skills will be required, and what they will be expected to do in the physics class (Redish, Saul & Steinberg, 1998). It had been established that students' responses actually depend upon their expectation, and their expectation affect their understanding of physics (Elby & Hammer, 2001; Lising & Elby, 2005). Physics educators and researchers understand and evaluate various dimensions of epistemological beliefs and attitudes held by experts and novice students in the discharge of their duties in the classroom (Thacker, 2003; Beichner, 2009).

Elby (2011) investigated the possible relationship between the learning behavior of students and epistemological beliefs. The researcher posited that significant relationship exist among these two variables. The awareness of prior-knowledge or learner's perception plays a significant role as the instructor plan his or her teaching activities to make students link prior knowledge to the new one. Consequently, attitude of students to physics is significant to their achievement in physics. An improved attitude is said to be a correlate of physics achievement (Redish, 2010; Semsar, Knight, Birol, & Smith, 2011). Subconsciously, students' epistemology and culture form significant component of their attitude which then influence their learning.

Several instruments have been developed by physics researchers and educators to measure the influence of epistemological beliefs on expectation of physics students. Some of these instruments are; Maryland Physics Expectation (MPEX) developed by Redish et al. in 1998, View About Science Survey (VASS) developed by Halloun and Hestenes also in 1998, Epistemological Beliefs Assessment for Physics Science (EBAPS) by Elby (2001), Colorado Learning Attitudes about Science Survey (CLASS) by Adams, Perkins, Podolefsky, Finkelstein, and Wieman, (2006). These instruments, referred as attitude surveys or affective surveys, probe students thinking about the process and the character involved in learning physics. They also provide adequate information on students' perception of their classroom experience to measure the perceptions systematically and quantitatively. The deployment of these instruments and other instrument alike have laid credence to the importance of belief, culture and attitude as predictors of performance and achievement of students within and outside the classroom.

Epistemological belief, Physics Education and Sustainable Development Goals

In the year 2015, 193 countries of the world under the United Nations came together to fight famines, drought, wars and plagues. Poverty eradication domestically and not in faraway place. Also, in individual cities, towns and villages. These countries knew things

didn't have to be this way. They knew there is enough food to feed the world, but that it wasn't getting shared. They knew there were medicines for HIV and other diseases, but they cost a lot. They knew that earthquakes and floods were inevitable, but that the high death tolls were preventable. They were also aware of billions of people worldwide who shared their hope for a better future. So, leaders from these countries created a plan called the Sustainable Development Goals (SDGs) which is an upgrade from Millennium Development Goals (MDGs). These countries set out 17 goals for the future, looking at 15 years ahead and what could be achieved in that period. If the decision payed off, that would rid the world of poverty, hunger, and humanity can be saved from the worst effects of climate change. The United Nations Development Program (UNDP) is charged with ensuring the SDGs becomes a reality.

The role of physics and science educators cannot be overemphasized in the attainment of the SDGs. The Director-General of UNESCO, Irina Bokova in 2015 reiterated the significance of education in alleviating the sufferings found in today's world. She stated that:

"A fundamental change is needed in the way we think about education's role in global development, because it has a catalytic impact on the well-being of individuals and the future of our planet. … Now, more than ever, education has a responsibility to be in gear with 21st century challenges and aspirations, and foster the right types of values and skills that will lead to sustainable and inclusive growth, and peaceful living together. Education can, and must, contribute to a new vision of sustainable global development." (UNESCO, 2015)

Integrating SDGs as physics educators, requires profound transformation of how we think and act as evolving learners and educators. To create a more sustainable world and to engage with sustainability-related issues, physics educators must become sustainability change-makers in and out of the classroom. The knowledge, skills, values and attitudes required to empower students/learners to contribute to sustainable development beget 21st century physics educators. Education in physics is therefore crucial as several of today's technology required for the development of various aspect of human life rely on the knowledge of physics. However, not all kinds of education support sustainable development.

Education that promotes economic growth alone may lead to an increase in unsustainable consumption patterns. The now well-established approach of Education for Sustainable Development (ESD) as established in the SDGs, empowers learners to take informed decisions and responsible actions for environmental integrity, economic viability and a just society for present and future generations. ESD unlike it previous predecessors aimed at developing competencies that empower individuals to reflect on their own actions, taking into account their current and future social, cultural, economic and environmental impacts, from a local and a global perspective. Physics educators are also expected to act in complex situations in a sustainable manner, which may require them to strike out and proceed in new directions; and to participate in socio-political processes, moving their

societies towards sustainable development. ESD has to be understood as an integral part of quality education, inherent in the concept of lifelong learning (UNESCO, 2015).

Conclusion and Recommendations

The integration of culture and language materials in the development of physics curriculum will enhance students' formation of concept. Deep meaning making of physics concepts should be envisaged by physics teachers/educators through matching of lesson presentation, topic discussion, and medium of instruction to the cultural background or cultural preference of the learners as this will represent their epistemological belief. The utilization of students' cultural and epistemological background in the design of curriculum materials may enhance their adaptation for meaningful making of physics concepts. Students with a familiar curriculum would be interested in the implementation of their knowledge and would positively influence the attainment of the SDGs. Since students concentrate more on deep understanding of the concepts while they are immersed in their own culture and language, this could foster their learning of physics concepts more as they are more connected.

When students see physics as something that would enrich the knowledge of their roots and native language, they view learning of physics concepts as something that has real-life significance and would be willing to participate more. When students' epistemology and culture are in line with the details of learning, they are able to engage in deep processing of information and physics concepts using the same schema of thinking they often use when they are engaging in their daily decision making. Consequently, they are able to employ patterns of assimilation similar to how they assimilate daily and real-life concepts thereby generating more interest which may positively influence their productivity towards the attainment of the SDGs. Learning physics using culture and language sensitive materials could enhance students experience in concept attainment of physics in their natural learning setting.

Physics students feel awkward, nervousness and anxious when entering a physics class chiefly because they anticipate a shift to a new world while entering their classroom. Contrarily, when the curriculum is domesticated, students feel at home and are more engaging in physics taught in culture and native language perspective. Such experience makes physics learning fun, comfortable, relaxing, and satisfying on the part of both the students and the teacher. Curriculum planners should be encouraged to integrate culture and language in the development of meaningful curriculum materials in physics.

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